

# Interim Cruise Ship Sampling Data Summary

**Alaska Department of Environmental Conservation  
Division of Air and Water Quality  
September 6, 2001**

This is an interim summary of information currently available to the Department of Environmental Conservation regarding the 2001 cruise ship air and wastewater monitoring program. Additional efforts are underway and will be reported in a final summary to be released as soon as possible following the end of this cruise ship season.

## Summary of Results

- Preliminary 2001 ambient air monitoring data collected in downtown Juneau area through late July 2001 show that the maximum levels measured for three pollutants of concern - sulfur dioxide (SO<sub>2</sub>), oxides of nitrogen (NO<sub>x</sub>), and particulates that are 2.5 micron in size or smaller (PM<sub>2.5</sub>) - are well below state and federal allowable limits.
- A total of 238 smokestack opacity readings have been taken in Juneau, Skagway and Haines from the start of the cruise season in May through August 28, 2001. Nineteen are currently under review for potential violations of the marine vessel visible air emission opacity standards. Last year there were 30 alleged violations for opacity violations and 2 alleged violations for air pollution violations.
- Six of the seven ships for which wastewater sampling results are summarized are discharging graywater within Alaska waters; only one is discharging blackwater in Alaska waters. One vessel is discharging both gray and black water outside Alaska waters. The samples are for conventional pollutants only. Difficulty in transporting samples from ships to the laboratory in a timely manner resulted in nearly 50 percent of the fecal coliform samples being invalidated. Some ships are being resampled for fecal coliform.
- Overall, the wastewater samples show variable pollutant levels, e.g.,
  - chlorine residual ranges from non-detectable to 70 mg/l (Water Quality standard 0.002 mg/l)
  - fecal coliform bacteria: 19 to 9,000,000 per 100 ml (HB 260 limit 200/100 ml)
  - pH: 4 to 10 (Water Quality standard 6.5 to 8.5)
  - and total suspended solids: 18 to 26,000 mg/l (HB 260 limit 150 mg/l)
- While they are not subject to enforcement action, some results for fecal coliform bacteria and total suspended solids from samples taken prior to the effective date of HB 260 exceed the state's new effluent limits.
- There also are wastewater sample results that exceed Alaska's water quality standards for residual chlorine or pH. However, it is important to recognize that effluent limits only apply to fecal coliform bacteria and total suspended solids and water quality

criteria are not directly applicable to the concentration of a pollutant in a holding tank, wastewater stream or effluent. The water quality criteria apply to the receiving water and typically are used in permits to calculate effluent limits, taking into account dilution in the receiving water. In this case, water quality criteria are shown in order to put the wastewater analytical results in perspective. The Science Advisory Panel, convened to assist in the evaluation of impacts, has developed initial estimates regarding the dilution of cruise ship wastewater discharges.

- One wastewater sample data set taken from a discharge line, of two collected after the July 1, 2001 effective date of the new state law, shows a total suspended solids of 189 mg/l, above the effluent standard of 150 mg/l. Both post-July 1 samples were well below the state's fecal coliform effluent standard of 200 colonies/100 ml under the new law. The one sample is under review by ADEC for consideration of a TSS violation.
- The cruise industry has introduced some procedures for stack emission reduction, including: gas turbine engines, enhanced combustion technology, and shore-side power hook-ups.
- The industry continues to evaluate, test and bring on-line new technology for advanced wastewater treatment. The USCG has approved two ships for wastewater discharge anywhere in Alaska (except specifically prohibited areas) this season, including in-port. These ships have achieved very low fecal coliform, TSS, biochemical oxygen demand (BOD) and chlorine sample results, through installation of state-of-the-art treatment technology.

## **I. Introduction**

The Alaska Department of Environmental Conservation (ADEC) presents a summary of the data obtained primarily under the auspices of the Alaska Cruise Ship Initiative. The information is presented in three sections covering 1) ambient air monitoring in downtown Juneau, 2) air opacity readings in Southeast Alaska for large cruise ships, and 3) wastewater sampling for certain large cruise ships while in port or underway. The summary covers data collected between May and mid/late July 2001 for air monitoring and wastewater sampling and through mid-August for air opacity readings.

The ambient air monitoring project is funded by the North West Cruiseship Association (NWCA), a trade organization representing several major cruise lines operating in Alaska. A contractor, under ADEC general direction, performs the air opacity readings in accordance Alaska's Air Quality Control Program (AS 46.03.14 and 18 AAC 50.070). As in the 2000 season, certain NWCA-affiliated cruise lines have also voluntarily funded independent sampling and laboratory analysis of wastewater generated by their large cruise ships.

Prior to the effective date of HB 260 large cruise ships participated in a voluntary sampling program through the Alaska Cruise Ship Initiative. Effective July 1, 2001, commercial passenger vessels (large cruise ships, small cruise ships and five Alaska state ferries carrying 50 or more overnight passengers based on lower berths) that discharge wastewater in Alaska waters are required to sample their wastewater, analyze it, and report data results to ADEC. While the following results apply to seven large commercial vessels, only two wastewater sampling data sets taken from one of the seven vessels were collected after the effective date of the new Commercial Passenger Vessel Environmental Compliance (CPVEC) program.

Small cruise vessels and the five largest Alaska State ferries are also conducting wastewater sampling in 2001, but no results have been obtained by ADEC to date.

## **II. Ambient Air Monitoring**

### ***Sampling***

The NWCA and ADEC are continuing efforts begun in 2000 to monitor the downtown Juneau area for possible health hazards associated with cruiseship stack emissions. The 2001 monitoring again focuses on three priority pollutants of most concern: sulfur dioxide (SO<sub>2</sub>), oxides of nitrogen (NO<sub>x</sub>), and particulates that are 2.5 micron in size or smaller (PM<sub>2.5</sub>). Wind direction and wind speed are also being collected at the three monitoring sites (Wickersham, Highlands, and Marine Way) to assist in identifying pollutant sources. The SO<sub>2</sub> and NO<sub>x</sub> are measured continuously on a 24-hour basis, and PM<sub>2.5</sub> is sampled every other day.

### ***Results***

Preliminary 2001 data show that the maximum levels measured for all pollutants are well below state and federal allowable limits (Appendix A). Maximum readings collected during May – July 2001 are between 9% and 34% of national ambient air standards. Similarly, the August – September 2000 maximum readings ranged between 10% and 40% of national standards.

### ***Comment***

So far so good. Although the time frame and sites used in the 2000 monitoring study differ from the 2001 study, the information is nevertheless indicative of the Juneau downtown ambient air exposure levels. The monitoring data, to date, do not raise any major concerns and suggest that downtown Juneau does not have an ambient air quality problem. However, no conclusions can be drawn until the 2001 ambient air monitoring project is completed. Further analysis of these and subsequent data will be performed.

## **III. Air Opacity Readings**

### ***Sampling***

The ADEC continues to monitor cruise ship emissions, in accordance with 18 AAC 50.070, Marine Vessel Visible Emission Standard. The regulation states that within 3 miles of the Alaska coastline, vessels cannot emit greater than 20 percent opacity for

more than a cumulative of three minutes in any one hour, with exemptions for docking, undocking, maneuvering, and starting engines. Certified personnel measure the air opacity using a visual observation, based on an Environmental Protection Agency method (40 CFR 60 Appendix A Method 9). In each year 2001-2004, the contractor will perform at least 250 observations in a minimum of four Alaska ports, with no more than 230 in a single port (i.e., at least 20 readings will be taken in ports other than Juneau).

### ***Results***

During the first 16 weeks of the 2001 cruise season (early May through late-August), the Department identified 20 potential opacity violations for seven large cruise ship companies out of a total of 238 readings (Juneau: 229; Skagway: 8; and Haines: 1) taken through August 28, 2001. One reading is not being pursued because it occurred during testing of the shore power project in Juneau. To date, the Department has received and reviewed corrective action reports for 16 of 19 potential violations but has not made recommendations regarding further enforcement action.

In comparison, ADEC issued 30 alleged violations for opacity violations and 2 alleged violations for air pollution-prohibited violations to seven large cruise ship companies operating in Alaska during a shorter period in 2000. A total of 235 readings were taken in Juneau (215), Skagway (11), Haines (6), and Ketchikan (3) during 11 weeks of observations from mid-July to late-September, 2000.

### ***Comment***

While it is too soon to draw conclusions, the cruise lines appear to be making some progress - there are fewer opacity violation issues so far this year as compared to 2000 which suggests that vessel owners are taking appropriate steps to improve performance and tighten up their operations. New technology developments (e.g. gas turbines, enhanced combustion technology and the shore power “plug in program” initiated in Juneau) also may be helping to reduce visible emissions. Even if so, there still is room for further improvement.

## **IV. Wastewater Sampling**

### ***Sampling***

The 2001 wastewater sampling and laboratory analysis are based on an ADEC-approved Quality Assurance Project Plan (July 10, 2001), that was developed under the Alaska Cruise Ship Initiative and funded by the NWCA.

Owners of 11 of the 24 large cruise ships operating in Alaska waters volunteered to have their ships sampled beginning in late May 2001.<sup>1</sup> Three ships are discharging both blackwater and graywater, while another seven are just discharging graywater within

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<sup>1</sup>The ten ships discharging inside and now under CPVEC: Statendam, Mercury, and Universe Explorer discharge blackwater and graywater in state waters. The Dawn Princess, Ocean Princess, Regal Princess, Sea Princess, Sun Princess, Norwegian Wind, and Norwegian Sky discharge graywater in state waters. The eleventh ship participating in voluntary program, but discharging outside is the Crystal Harmony.

state waters. Only one ship in the voluntary program is discharging gray and black water outside Alaska waters.<sup>2</sup>

Ships discharging in state water after July 1 are subject to effluent limits under the new state law.<sup>3</sup> As a result, the ten ships discharging inside Alaska waters also are required to conduct wastewater sampling of their inside discharges under the new state law.

ADEC has received sample results for seven of the 11 ships so far this season that are the subject of this report. Six ships are discharging graywater within state waters; only one is discharging blackwater in Alaska waters. One is discharging both gray and black water outside Alaska waters. Of the samples covered by this interim report, only two data sample sets from one vessel are subject to the new law since they were taken after July 1.

Independent contractors conduct all the sample collection, testing and quality assurance with oversight and additional review by DEC personnel. Of the 35 sample results received by ADEC to date, 29 were taken from small collection tanks or larger holding tanks, while another 6 were taken from discharge lines. Between two and five waste streams were sampled on each ship.

To date only reports of conventional pollutants (fecal coliform, total suspended solids, biochemical oxygen demand, chemical oxygen demand, chlorine, pH and conductivity) have been received by ADEC. Voluntary sampling of priority pollutants (metals and organics), that were identified by ACSI participants based on recommendations from the ACSI-affiliated Science Advisory Panel, is underway and results will be obtained by ADEC later this year.

Until new technology wastewater treatment systems are installed and proven, most large cruise ships will not discharge blackwater in Alaska waters. A number of systems are being tested this season, including the Zenon bioreactor/ultrafiltration/ultraviolet system, reverse osmosis/UV/activated carbon filtration system, Hamworthy biomembrane system, and Alfa Laval/Hydrox oxidation system. The USCG has approved two ships – Statendam (Holland America Line) and Mercury (Celebrity Cruises) -- for discharge anywhere in Alaska this season (except specifically prohibited areas), including in-port. These ships have achieved very low fecal coliform, TSS and chlorine sample results, based on the installation of state-of-the-art treatment technology for onboard wastewater treatment systems.

### ***Results***

With 29 wastewater samples from holding tanks on five large cruise ships reported to date, the 2001 results show considerable variability of conventional pollutants. Results of limited sampling of discharge lines to date (6 samples from two additional ships) indicate

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<sup>2</sup> Fourteen large cruise ships are discharging all wastes outside Alaska waters while another seven are discharging black water outside Alaska waters. These are not subject to sampling under state law.

<sup>3</sup> Under the new state law, gray water standards do not apply until 2003 for vessels who submit an acceptable plan for interim protective measures.

generally lower levels of conventional pollutants. Overall, the wastewater sampling data results show variable pollutants levels , e.g.:

- chlorine residual ranges from non-detectable to 70 mg/l (Water Quality standard 0.002 mg/l)
- fecal coliform bacteria: 19 to 9,000,000 per 100 ml (HB 260 limit 200/100 ml)
- pH: 4 to 10 (Water Quality standard 6.5 to 8.5)
- and total suspended solids: 18 to 26,000 mg/l (HB 260 limit 150 mg/l)

Appendix B presents individual ship sample records. All wastes sampled are gray water, except for ship Z where they are a combination of gray and black water. Complications related to onboard sampling locations and difficulty in transporting samples from ships to the laboratory within the maximum 6-hour period led to nearly 50 percent of the fecal coliform samples being invalidated. Some additional fecal coliform sampling will occur this season.

Some results for fecal coliform bacteria and total suspended solids from samples taken prior to the effective date of HB 260 exceed the state's new effluent limits but these are not subject to state enforcement action.

There also are wastewater sample results that exceed Alaska's water quality standards for residual chlorine or pH. However, it is important to recognize that effluent standards only apply to fecal coliform bacteria and total suspended solids and water quality criteria are not directly applicable to the concentration of a pollutant in a holding tank, wastewater stream or effluent. The water quality criteria apply to the receiving water and typically are used in permits to calculate effluent limits taking into account dilution in the receiving water.<sup>4</sup> In this case, water quality criteria are shown in order to put the wastewater analytical results in perspective.

The Science Advisory Panel, convened to assist in the evaluation of impacts, has developed initial estimates regarding the dilution of cruise ship wastewater discharges. The Science Advisory Panel estimates that wastewater discharges will rapidly achieve a dilution factor of 12,000 or more. See Appendix B page 2. Additional information is currently being gathered on what this actual dilution is likely to be and to further evaluate environmental and public health impacts. As authorized by the new state law, regulations will be developed, as necessary, to address concerns with commercial passenger vessel wastewater discharges.

One sample data set from a discharge line, of two sample sets taken from one cruise ship after the July 1, 2001 effective date of the new State law, shows a total suspended solids (TSS) of 189 mg/l, above the effluent standard of 150 mg/l. Both post-July 1 samples were well below the state's fecal coliform effluent limit of 200 colonies/100 ml under the new law. Discharge log records indicate that the cruise ship was discharging within

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<sup>4</sup> Other factors considered when determining permit limits include such criteria as the location of the discharge, water body size or other characteristics, and possible impacts on human health or sea life.

Alaska waters, so the one questionable sample is under review by ADEC for consideration of a TSS violation.

***Comment***

Sampling results are inconclusive and limited – we have information for 7 of the 11 vessels who are testing that covers conventional pollutants (no data for priority pollutants); most are for gray water only; and many of the results for fecal coliform are invalid because they exceeded holding time limits. However, what we've seen so far is consistent with last year - variable with some high numbers. This is likely to continue until all vessels have installed new or improved treatment systems. Recent technology developments suggest that this can be done; possibly within the next few years. In any event, there are fewer pollutants being discharged into the Inside Passage this season due primarily to the fact that many more vessels are discharging outside Alaska waters. These discharges are further away from our beaches and population centers. Science Panel and related assessment efforts will shed more light on the subject of environmental and public health impacts.

More information about cruise ship wastes and several of the Science Advisory Panel's reports and comments can be viewed on the ADEC web site:

<http://www.state.ak.us/dec/cruise>

## APPENDIX A

### Interim Summary: Juneau Ambient Air Quality Monitoring Study May - July 2001 and August 2000 Study Results

NOTE: 2001 DATA ARE PRELIMINARY

Pollutant/Average Interval	3-hr SO2 (ppb)	24-hr SO2 (ppb)	Ave. SO2 (ppb)	Ave. NO2 (ppb)	24-hour PM 2.5 (ug/m3)	Ave. PM 2.5 (ug/m3)
NAAQS	500	140	30	50	65	15
Wickersham Max: Year-to-Date	46	17	4.4	17	5.9	3.8
Highlands Max: Year-to-Date	29	15	3.9		5.9	3.7
Marine Way Max: Year-to-Date	38	25	3.8		7.1	4.3
Max. Concentration 2001 Year-to-Date	46	25	4.4	17	7.1	4.3
Maximum as % of NAAQS 2001 Sampling	9%	18%	15%	34%	11%	29%
Max. Concentration 2000 Study	52	14	6.5	11	10.0	6.0
Maximum as % of NAAQS 2000 Sampling	10%	10%	22%	22%	15%	40%

ppb = parts per billion

ug/m3 = micrograms per cubic meter

NAAQS = National Ambient Air Quality Standard

Shaded cells indicates that the pollutant is not measured at the site.

“Max Concentration 2001 Year-to-Date” presents the maximum measured concentration at any site during May 19 – July 16, 2001 (PM<sub>2.5</sub>.) and May 19-July 31, 2001 SO<sub>2</sub> & NO<sub>x</sub>

“Max. Concentration 2000 Study” presents the maximum measured concentration at any site during the August 2000 monitoring program.

Source: ADEC, August 27, 20007



## APPENDIX B Interim 2001 Wastewater Sampling Results for Certain Large Cruise Ships

Ship	Tank Identification	Discharge Identification	Waste Type	Sample Date	Ammonia mg/l	BOD mg/l	COD mg/l	Cl-free mg/l	Cl-Tot mg/l	pH	TSS mg/l	Fecals fc/100ml	Cond umhos/cm	O&G (HEM) mg/l
B	B1-GWTankG		Accom	5/24/2001	Notreq'd	230	300	ND	3	7	79	300,000	96	N/A
B	B1-GWTankH		Galley	5/24/2001	Notreq'd	5,900	6,400	ND	ND	4	2,300	5,000	1,200	N/A
B	B1-GWTankE		Accom	5/24/2001	Notreq'd	130	200	2	3	7	38	300,000	100	N/A
Y *	Y1-GWTank6		Accom	5/25/2001	Notreq'd	450	1,200	0	2	8	55	33	430	N/A
Y *	Y1-GWTank4		Accom	5/25/2001	Notreq'd	130	220	0	4	7	22	22,000	470	N/A
Y *	Y1-GWTank5		Accom	5/25/2001	Notreq'd	170	300	0	2	8	56	350,000	270	N/A
Y *	Y1-GWTank8		Galley	5/25/2001	Notreq'd	1,600	1,700	1	3	8	880	50	1,100	N/A
O	O1-GWTank9249		Holding	5/30/2001	Notreq'd	510	690	ND	ND	7	370	9,000,000	1,310	14
O	O1-GWTank9149		Holding	5/30/2001	Notreq'd	770	1,100	ND	ND	6	710	9,000,000	1,020	44
O	O1-GWTank2102		Holding	5/30/2001	Notreq'd	110	540	1	3	10	260	ND	3,970	ND
B	B2-DB11tank(GW)		Accom	6/1/2001	Notreq'd	190	450	0	2	8	66	Footnote1	440	5.6
B	B2-DB8tank(GW)		Galley	6/1/2001	Notreq'd	1,300	2,700	ND	ND	4	270	Footnote1	1,300	ND
B	B2-DB4tank(GW)		Accom	6/1/2001	Notreq'd	210	460	ND	0	10	66	Footnote1	410	190
B	B2-DBLNDtank(GW)		Laundry	6/1/2001	Notreq'd	120	410	0	0	10	23	Footnote1	350	ND
T	T1-GWCTGLYtank		Galley	6/1/2001	Notreq'd	1,600	2,300	ND	4	10	780	30,000	665	ND
F		DB4GWdisch	Acc+Laun	6/5/2001	Notreq'd	1,000	2,300	ND	ND	4	230	Footnote1	3,240	ND
F		DB8GWdisch	Acc+Laun	6/5/2001	Notreq'd	550	1,100	ND	ND	4	150	Footnote1	1,150	ND
F		DB11GWdisch	Acc+Laun	6/5/2001	Notreq'd	97	240	ND	ND	7	56	Footnote1	4,100	ND
F		DB5GWdisch	Galley	6/5/2001	Notreq'd	380	930	ND	ND	6	160	Footnote1	3,870	ND
D	D1-GWtankF(#6)		Accom	6/5/2001	Notreq'd	120	240	18	19	9	25	ND	503	ND
D	D1-GWtank4(D)		Accom	6/5/2001	Notreq'd	100	250	50	70	8	22	ND	4,220	ND
D	D1-GWtank3(E)		Accom	6/5/2001	Notreq'd	500	970	0	4	9	100	170	1,080	ND
D	D1-GWtank		Galley	6/5/2001	Notreq'd	760	1,400	1	30	9	130	ND	1,180	11
T	T1-B-DB11tank (GW)		Galley	6/7/2001	Notreq'd	7,800	54,000	ND	ND	4	26,000	Footnote1	2,670	7.8
T	T1-B-DB8tank(GW)		Accom	6/7/2001	Notreq'd	250	510	ND	ND	7	54	Footnote1	401	6.9
T	T1-B-DB6tank(GW)		Laundry	6/7/2001	Notreq'd	1,400	2,600	ND	ND	4	400	Footnote1	3,360	ND
T	GW-8tank		Accom	6/8/2001	Notreq'd	170	390	4	8	9	87	170,000	418	ND
T	Fish Shop		Galley	6/8/2001	Notreq'd	1,000	1,900	0	2	7	580	ND	1,850	ND
D	Tank F (GW)			6/12/2001	Notreq'd	600	1,200	2	4	7	94	Footnote1	399	ND
D	Fish Shop		Galley	6/12/2001	Notreq'd	550	1,100	2	4	8	170	Footnote1	1,150	ND
D	Tank G (GW)			6/12/2001	Notreq'd	220	380	ND	0	8	18	Footnote1	183	ND
D	Butcher Shop		Galley	6/12/2001	Notreq'd	720	1,500	Not tested	4	8	130	Footnote1	1,160	ND
D	Tank E (GW)			6/12/2001	Notreq'd	110	230	Not tested	3	8	27	Footnote1	337	Not tested
Z		TWW Fwd B+G	BW+GW	7/13/2001	3.49	190	973	0	3	7	128	19	34,400	5.4
Z		TWW Aft B+G	BW+GW	7/13/2001	0.34	134	1,100	1	5	7	189	60	34,400	5.4

Continuation of sampling results sheet

Ammonia mg/l	BOD mg/l	COD mg/l	Cl-free mg/l	Cl-Tot mg/l	PH	TSS mg/l	Fecals fc/100ml	Cond umh/cm	O&G (HEM)
Maximum	7,800	54,000	50	70	10	26,000	9,000,000	34,400	190
Minimum	97	200	0	0	4	18	19	96	5.4
Geometric mean	395	860	1	3	7	139	11,148	1,036	13
Median	380	970	1	3	7	128	26,000	1,100	7.8

**Pollutant levels after applying a 12,000: 1 dilution ratio**

Maximum	0.6500	4.5000	0.0042	0.0058	2.1667	750.0000	0.0158
Minimum	0.0081	0.0167	0.0000	0.0000	0.0015	0.0016	0.0005
Geometric mean	0.0329	0.0716	0.0001	0.0002	0.0115	0.9290	0.0011
Median	0.0317	0.0808	0.0001	0.0003	0.0107	2.1667	0.0007

**Alaska Water Quality Standard(18AAC70.020(b))**

**0.0020 6.5-8.5 14 0.015**

BW = treated sewage or "blackwater"

GW = graywater

ND = nondetectable level

BOD = Biochemical Oxygen Demand

COD = Chemical Oxygen Demand

Cl = Chlorine

TSS = TotalSuspendedSolids

Cond = Conductivity

N/A = Not analyzed

O&G = oil and grease

**Note: \* = Ship Y is not discharging within Alaska waters.**

**Footnote1:**

Sample exceeded Holding time; ship being resampled for fecals

Source: AK Dept. Env. Conservation August 29, 2001